Syllabus

EE 379K-WC Wireless Communications Laboratory

Lecture: Mondays & Wednesdays 5:00-6:30pm ENS 116

Lab Sections (unique number 15810): Wednesday 9:30-12:30 ENS 113 TA: Hoojin Lee
Lab Sections (unique number 15815): Tuesday 7:00-10:00 ENS 113 TA: Ketan Mandke
Lab Sections (unique number 15820): Wednesday 7:00-10:00 ENS 113 TA: Ketan Mandke
Lab Sections (unique number 15825): Thursday 7:00-10:00 ENS 113 WILL BE CANCELED

Instructor Information
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Teaching Assistant Information
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Office hours location: Wireless lab

Hoojin Lee
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Office hours location: Wireless lab

Prerequisites (strictly enforced)
EE 345S Real-Time Digital Signal Processing or EE 351M Digital Signal processing or EE 360K Intro to Digital Communications.

Reading Materials (required)
Telecommunications Breakdown: Concepts of Communication Transmitted via Software-Defined Radio by C. Richard Johnson and William A. Sethares
Publisher: Prentice Hall, ISBN: 0131430475 Published: August 22, 2003
Course Introduction

Wireless communication is fundamentally the art of communicating information without wires. In principle, wireless communication encompasses any number of techniques including underwater acoustic communication, semaphores, smoke signals, radio communication, and satellite communication, among others. The term was coined in the early days of radio, fell out of fashion for about fifty years, and was rediscovered during the cellular telephony revolution. Wireless now implies communication using electromagnetic waves -- placing it squarely within the domain of electrical engineering. This brings us to the course at hand.

Wireless communication techniques can be classified as either analog or digital. The first commercial systems were analog including AM radio, FM radio, television, and first generation cellular systems. Analog communication is gradually being replaced with digital communication. The fundamental difference between the two is that in digital communication, the source is assumed to be digital. Every major wireless system being developed and deployed is built around digital communication including cellular communication, wireless local area networking, personal area networking, and high-definition television. Thus the spotlight of this class will focus on digital wireless communication.

This class approaches wireless communication from the perspective of digital signal processing (DSP). No background in digital communication is assumed, though it would be helpful. The utility of a DSP approach is due to the following fact: wireless systems are bandlimited. This means that with a high enough sampling rate, thanks to Nyquist’s theorem, we can represent the bandlimited continuous-time wireless channel from its samples. This allows us to treat the transmitted signal as a discrete-time sequence, the channel as a discrete-time linear time-invariant system, and the received signal as a discrete-time sequence.

In this class we take an experimental approach to wireless digital communication. We will use a National Instrument’s based software defined radio platform where the radio can be programmed software (in this case LabVIEW) instead of implemented using hardware. The focus will be on the design, implementation, evaluation, and iterative optimization of a digital wireless communication link. A three-hour laboratory period will complement the usual three-hour lecture period each week.

At the end of this class, you will have constructed your own wireless communication link. By the end of this course, you should be able to describe the design challenges associated with building a wireless digital communication link. You should be able to define and calculate bit error rates for some common modulation schemes. You should know the difference between binary phase shift keying and quadrature phase shift keying as well as how to implement them. You should understand the connection between pulse-shaping and sampling. You should know how to define excess bandwidth for a raised-cosine pulse. You should understand how to obtained a sampled channel impulse response from a continuous time propagation channel. You should understand how to train and estimate the coefficients of the channel. You should understand the various kinds of synchronization required and how to compensate for different sources of asynchronicity. You should be able to implement everything you learn on our software defined radio platform.
Outline of Experiments

- Introduction to LabVIEW and the National Instruments RF Hardware
- Baseband QAM Modulation
- Channel Estimation
- Synchronization
- Frequency Offset Estimation and Correction
- OFDM Modulator and Demodulator
- OFDM Synchronization, Frequency Offset, and Channel Estimation.

Course Organization

The course consists of two lectures per week and a single laboratory session. The lecture will cover the theory of wireless communication to prepare you for implementation in the lab. Lectures will be supplemented by homework assignments every couple weeks, consisting of a few problems to test what you learned in class. The laboratory sessions will consist of two parts: a prelab that you conduct at home before the lab begins and the lab itself. Doing the prelab ahead of time is very important and is mandatory for your participation in the lab. After the labs you will summarize your lab findings in lab reports.

Technical Area Fulfillment

This course counts as a technical area elective for the Communications / Networking technical area and the Signal / Image Processing technical area. Consult your academic advisor to see if it can count as a technical elective in other areas.

Electronic Course Site

We will use Blackboard http://courses.utexas.edu/ to deliver extra reading materials, homework assignments, and electronic lecture notes. You should be able to log in if you have a valid UT ID and are registered for this class.

Course Policies

Prelabs – Every lab session will have prelab that is due at the beginning of class on Monday, the week for that session. The prelab includes a mixture of problems and programming to prepare you for that week’s experiment. You may work on the prelab with your lab partner but not with other students but all work must be your own. You may not participate in the lab without a prelab. Copying another student’s prelab is considered cheating and the appropriate action will be taken. Prelabs, homeworks, tests, and solutions from previous offerings of this course or offerings of related courses on the Internet are off limits. Use of these materials will be considered cheating and appropriate action according to the Academic Dishonesty Policy listed below will be taken.

Due dates and late policy – All prelab assignments will be due at the beginning of class on Monday. No late prelabs will be accepted as you need to be prepared for the lab. All homework assignments will be due at 5pm on Fridays in ENS 113. You should be able to fit the paper between the door. Homework received after 5:05pm will count for 50% of the grade you receive until 5:00pm on Saturday when it will be 0. Lab reports are due in your lab section the week they are due.
Exams - There will be three midterm exams in the semester based on topics covered in the lecture and the lab. There will not be a final exam.

Participation – Attendance in the laboratory session is mandatory. Attendance in the lecture is optional. Please do not attend the lecture if you simply intend to sleep in the classroom. There will be frequent surveys on all assignments. Completion of occasional anonymous surveys through blackboard is mandatory.

Questions and discussion in class is encouraged. Participation will be noted. Please be aware that participation is not the same as attendance. Please do not attend class if you simply intend to sleep in the classroom.

Evaluations - Course and instructor evaluations will occur the third week of April.

Messaging - Receiving and placing cellular calls during class is prohibited. Likewise interactive text messaging, checking email, etc. in class is prohibited.

Grading

- 10% Homework
- 50% Lab experiments, pre-labs and reports
- 35% 3 Quizes
- 5% Participation including attendance in laboratory

Important Dates

Last day to add or drop a class (without chair or dean approval): January 20
Last day to add a class (except in rare cases) for undergraduates: February 1
Last day to drop a class (with possible refund): February 1
Last day to drop a class (without academic penalty): February 13
Last day to drop a class (with Dean’s approval): March 27
Spring break: March 13 – 18

Academic Dishonesty

Faculty in the ECE Department are committed to detecting and responding to all instances of scholastic dishonesty and will pursue cases of scholastic dishonesty in accordance with university policy. Scholastic dishonesty, in all its forms, is a blight on our entire academic community. All parties in our community -- faculty, staff, and students -- are responsible for creating an environment that educates outstanding engineers, and this goal entails excellence in technical skills, self-giving citizenry, and ethical integrity. Industry wants engineers who are competent and fully trustworthy, and both qualities must be developed day by day throughout an entire lifetime. Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, falsifying academic records, or any act designed to give an unfair academic advantage to the student. The fact that you are in this class as an engineering student is testament to your
abilities. Penalties for scholastic dishonesty are severe and can include, but are not limited to, a written reprimand, a zero on the assignment/exam, re-taking the exam in question, an F in the course, or expulsion from the University. Don’t jeopardize your career by an act of scholastic dishonesty. Details about academic integrity and what constitutes scholastic dishonesty can be found at the website for the UT Dean of Students Office and the General Information Catalog, Section 11-802.

**University Policies and Privacy**

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities.

In spring 2001, Web-based, password-protected class sites will be associated with all academic courses taught at The University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1.

For information on restricting directory information see: [http://www.utexas.edu/student/registrar/catalogs/gi00-01/app/appc09.html](http://www.utexas.edu/student/registrar/catalogs/gi00-01/app/appc09.html)